

Hot Tips on Welding Safety

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A Safety Support Pamphlet

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HOT TIPS ON WELDING SAFETY

A SAFETY SUPPORT PACKET

Industrial Safety Fact Sheet

1. Injuries, death, and disability are results of accidents. Costs combined with worker pain, disability, and loss of life emphasize the importance of accident prevention in all levels of industrial maintenance operations.
2. The National Safety Council estimates that the value of goods and services each worker must produce to offset the cost of work injuries is \$350. Work injuries in the United States cost more than \$37.3 billion in 1985. According to the National Health Interview Survey, more than 13 percent or 9 million injuries per year are incurred in industrial places.
3. Accidents from transporting, handling, and storing of welding equipment and gases, welding operations, and equipment maintenance are numerous and may occur at any level from organizational through GS/DS maintenance operations. Most accidents are caused from heat/spark burns to eyes, skin and clothing; electrical hazards; failure to use protective equipment; poor housekeeping; improper procedures; and occasional materiel failure.
4. Use of protective equipment, proper training, use of technical manuals, compliance with safety and OSHA requirements, teamwork, and individual awareness are necessary to minimize unnecessary disabling injury.
5. Good judgment and proper supervision are instrumental in accident prevention. Incidences of exposure to paint/metal fumes and electrical hazards of welding operations, blindness, burns, and death can be avoided by controlling hazardous conditions, by proper education, and by following the rules. No one can prevent accidents like you can.

WELDING OPERATIONS

TAILGATE SESSIONS

Tailgate Sessions

Short Safety Briefings for Welders and Welding Equipment Operators

1. What is a tailgate session? Tailgate sessions got their name from employees sitting on the tailgate of a truck while receiving a short safety briefing for an upcoming job.
2. The use of this type training for welding personnel has obvious advantages:
 - a. It shows safe performance is one of the work standards.
 - b. It allows sharing of safety information about upcoming jobs.
 - c. It can be done with minimal planning during nonpeak work hours.
 - d. It shows supervisory support of safe activities.
 - e. It can be keyed to specific individuals or work groups without requiring entire unit participation.
 - f. It lends authenticity to the safety program by keying on the job at hand and therefore avoids generalization.
 - g. It raises the safety awareness level of personnel.
3. Implementation:
 - a. Identify topics that are pertinent to the unit's maintenance activities (see list of additional tailgate topics for recommendations).
 - b. Develop hip-pocket tailgate sessions on selected topics.
 - c. Distribute tailgate sessions to supervisors and discuss when and where they are to be used (sessions are included in this kit).
 - d. Have individuals from the command group or element occasionally conduct tailgate sessions to reiterate and reinforce their concern for safety.
 - e. Continually revise and update the tailgate sessions to ensure applicability.

GENERAL HAZARDS OF WELDING

The process of welding is the joining of two metal parts where the bond is formed by heating the metal to suitable temperatures, with or without application of pressure and with or without the use of filler materials. Welding is usually considered to include the cutting, brazing, and soldering of metal components. Additionally, there are several types of welding processes that are suitable for certain purposes and metals. Each process has its own particular hazard. All processes have certain common hazards found in all types of welding operations.

Common hazards and potential injuries involved in welding are:

- . Burns to skin from hot metal and sparks.
- . Clothing catching on fire from flame, hot metal, and sparks.
- . Burns to eyes from sparks, hot metal, and ultraviolet rays.
- . Welding operations on fuel tanks or around flammable vapors. This includes carrying cigarette lighters in pockets while welding.
- . Inhalation of fumes from rods, fillers, and burning metal.
- . Improper use and maintenance of equipment.
- . Failure to use personal protective equipment during metal preparation when using corrosive acids and while welding.

All the written procedures in TMs and SOPs won't prevent a single accident unless the procedures are practiced by the worker. Frequently, supervisors permit the use of unsafe or incorrect procedures, allow shortcuts, or fail to closely monitor personnel. Training of personnel in safety and task performance, proper supervision, use of personal protective clothing and equipment, and following rules and regulations are valuable tools to prevent needless accidents and injury. Workers and supervisors alike have a joint responsibility to minimize accidental injury to themselves and coworkers. Fewer accidents improve organizational effectiveness and morale for everyone.

OXYACETYLENE WELDING OPERATIONS

In oxyacetylene welding, one of the gas-welding processes, the metal is heated by the hot flame of a gas-fed torch. The metal melts and fuses together to produce the weld. In many cases, additional metal from a welding rod is melted into the joint which becomes as strong as the base metal.

Many of the hazards in oxyacetylene welding can be minimized by careful consideration of the following points:

. The welding flame and the sparks coming from the molten puddle can cause any flammable material to ignite on contact. Therefore, flame-resistant clothing must be worn by the welder and the welder's hair must be protected. Gloves designed for welding should be worn. Welding or cutting should not be accomplished near flammable materials such as wood, oil, waste, or cleaning rags. Never weld or cut on enclosed containers.

. In addition to the risk of eye injury from flying sparks, the eyes may be strained if the intense light is not filtered out by proper lenses. Therefore, the eyes should be protected at all times by approved safety glasses and the proper shield. A number 5 lens is the standard quality. Sunglasses should never be used for this purpose.

. Fluxes used in certain welding and brazing operations produce fumes which are irritating to the eyes, nose, throat, and respiratory system. The fumes produced by overheating lead, zinc, and cadmium are a serious health hazard when inhaled even in small quantities. The oxides produced by these elements are poisonous. Welding should be performed in well-ventilated areas or with adequate respiratory protection. The operator should not expose others to fumes produced by welding.

. Equipment, hoses, and connections should be periodically checked for leaks by using soap and water - never a match. Defective or leaking cylinders should not be used. Leaking acetylene cylinders (around the safety fuse plug) should be taken outside away from heat and spark, and the valve opened slightly to permit the contents to escape. Oxygen cylinders with leaky valves, safety fuse plugs, and discs should be set aside and marked for the attention of the supplier. Never attempt to repair oxygen cylinder valves.

OXYGEN AND ACETYLENE CYLINDERS AND REGULATORS

Hazards are present when gases are compressed, stored, transported, and used under very high pressures. Oxygen and acetylene are delivered to the user under high pressure in steel cylinders. Cylinders are built, filled, and transported according to Interstate Commerce Commission regulations. Before transporting, all cylinders must be secured in an upright position and cylinder caps must be in place.

Cylinders must also be capped and secured in an upright position during storage away from all sources of heat, spark, and open flame. According to OSHA standards, cylinders must be stored at least 20 feet away from combustible materials and oxygen cylinders must meet the 20-foot separation from combustibles and fuel-gas cylinders such as acetylene. However, Army standards may meet or exceed OSHA standards. In accordance with AR 700-68, acetylene cylinders must be stored at least 100 feet from oxygen cylinders and oxygen cylinders should not be stored within 50 feet of any flammable or combustible material. Smoking is also restricted and posted for a 50-foot distance. Empty cylinders should be kept separate from full cylinders and should be tagged. Cylinder valves should always be closed when not in use, even when the cylinder is empty.

A simple demonstration of the volatile qualities of a compressed gas cylinder is that of an inflated balloon. The explosive burst when punctured or heated, or the sudden flight of the balloon when released shows that compressed gas, even in small amounts, has considerable force. Dropping a cylinder, hitting it with heavy or sharp tools, or striking an electric arc on it can cause the cylinder to explode with enough force to cause injury or death. Never lift cylinders by the cap or valve and never try to pry the cylinder at this point to remove the cap or loosen the cylinder from frozen ground. Cylinders that are frozen to the ground or that have frozen valves should be loosened with warm water. Boiling water or flame should not be used. Never use compressed oxygen for pneumatic tools or as a substitute for compressed air.

Oxygen and acetylene regulators reduce the high cylinder pressure to usable working pressures. Most regulators are equipped with gages which indicate the amount of pressure in the cylinder and the working pressure in the hoses and torch. Never use acetylene at pressures more than 15 PSI. Never use oxygen or acetylene cylinders without a regulator and check valve. Always open valves slowly. Since gages often get out of calibration, they are only indicators of cylinder and working pressures. Use proper procedures to adjust pressure, as contained in TM 9-237. Defective gages, regulators, and other equipment should be removed from service and repaired by qualified personnel only.

OXYACETYLENE SET UP/OPERATION SAFETY TIPS

Proper setup is important. Always doublecheck equipment before using. Never use torches, regulators, hoses, and other equipment designed for acetylene on oxygen cylinders. Some safe ideas are as follows:

- . Ensure regulators, gages, and backflow protection are included in all setup operations.
- . Secure cylinders in an upright position and do not stand facing cylinder valve outlets or point them towards each other.
- . If it is necessary to blow out the acetylene hose, do it in a well-ventilated place, free of sparks, flame, and other sources of ignition. Never light an acetylene torch in a confined space. Always ensure proper ventilation.
- . Purge both acetylene and oxygen lines prior to igniting torch. Failure to do this can result in personal injury and damage to equipment.
- . Ensure the regulator tension screw is released before opening valves. Perform proper checks on equipment before proceeding with the lighting of the torch.
- . Regulators with leakage of gas between the regulator and the nozzle should be repaired immediately to prevent damage to other parts of the regulator and injury to personnel. Damaged inlet connection threads may cause fires by ignition of the leaking gas. Defective welding torches which are sources of gas leaks should be immediately corrected as they result in flashback and potential explosion.
- . Open the acetylene cylinder valve 1/4 to 1/2 turn (NEVER open more than 1 1/2 turns). Always leave the t-wrench on the valve stem while the cylinder is in use in case of emergency shut off.
- . When using compressed oxygen, open the oxygen cylinder all the way (this prevents valve stem leakage).
- . When the welding or cutting operation is completed turn off the acetylene torch valve first and then the oxygen. Regulators and hoses should be purged when left overnight or unattended.
- . Never put down the torch until the gas is completely shut off. Do not hang torches from the regulator or other equipment so that it comes into contact with the cylinder.
- . Ensure only trained and authorized personnel are allowed to setup and operate oxyacetylene equipment.

WELDING SHOP SAFETY TIP

Some welding rods are 36-inches long. For those shops that have several welders working in a particular area, bending the end of the rod into a hook shape will prevent unnecessary injury from someone who happens to walk by your work area. Also, it helps identify the cool end of the rod.

MIG AND TIG WELDING OPERATIONS

Gas Metal-Arc (MIG) welding is a process in which a consumable bare-wire electrode is fed into a weld at a controlled rate of speed, while a blanket of inert argon gas shields the weld zone from atmospheric contamination. Gas Tungsten-Arc (TIG) welding is when an arc is struck between a virtually nonconsumable tungsten electrode and the workpiece. The heat of the arc causes the edges of the workpiece to melt and flow together. Filler rods are often used to fill gaps in the joints. As in MIG welding, argon gas shields the work areas from air and oxidation.

Electric arcs and gas flames both produce ultraviolet and infrared rays which have a harmful effect on the eyes and skin upon continued or repeated exposures. A typical effect of ultraviolet exposure is "sunburning" of the eyes and skin. Although these injuries are usually temporary in nature, permanent eye injury and retinal burns may result from looking at welding arcs with unprotected eyes. Ultraviolet radiation may be amplified several times and the intensity several times stronger in argon-shielded welding operations.

Constant exposure to ultraviolet rays can disintegrate cotton clothing. It is recommended that clothing cover the body and be made of wool, leather, or other flame-resistant nonreflective clothing in order to protect the skin. A leather protective apron, welder's gloves, and welding helmets with a #11- or #12-shade welding plate. In addition, the operator should wear #2-shade flash goggles with wide side shields under the helmet.

MIG and TIG welding operations should be shielded and isolated so that other workers will not be exposed to direct or indirect rays and sparks. Welding operations should be away from all combustibles and at least 50 feet from flammable vapors. Welding booths should be coated with nonreflective paint and provided with flameproof curtains or screens. Booth air circulation should be at the floor-level.

Inert-gas-welding operations have certain dangers associated with them which are particular to the process or are amplified by the type of welding, rod, or metal composition. For example, ozone concentration increases with the type of electrode used, amperage, extension of arc time, and increased argon flow. If welding is carried out in confined spaces or in areas of poor ventilation, ozone can reach dangerous levels. Heat and carbon dioxide mix to become carbon monoxide which can also be dangerous under the right conditions. Fumes from acid cleaners, welding fillers, and metal can prove to be dangerous in the welder's breathing zone. The vapors from some chlorinated solvents break down under ultraviolet radiation and form a toxic gas.

Items such as trichloroethylene and other solvents should be removed from the welding area. Adequate ventilation should be provided to remove fumes produced by the process, as set forth in American National Standards Institute (ANSI) Standard Z-49.1 on safety in welding. In areas not meeting these requirements, proper respiratory protection should be worn, especially when working with cadmium or mercury-coated base metals.

ELECTRICAL HAZARDS OF ARC WELDING

Either AC or DC power can be used in arc welding of any kind to include carbon arc cutting and cutting with heavily coated electrodes. With small diameter electrodes used on thin metal sheets for normal welding operations the amperage is normally about 10 to 50 amps. For most manual welding, amperage should never exceed 400 or 500 amps due to the heat that the operator must withstand.

Open-circuit voltage is the voltage between the electrode holder and the ground during the "off" arc or "no load" period. Open circuit voltages on standard units are not high compared to other processes and, typically, the workpiece is grounded. However, unless care is taken by the operator, there is always the potential that the operator may become grounded. If the operator is not properly trained or fails to use protective equipment he can become exposed to this voltage when changing electrodes, setting up work, or when changing positions. The danger is particularly great in hot weather when the welder is sweaty.

There are several things that welders can do to prevent injury.

. The welder should ensure that bare metal components of the electrode, electrode holder, and the workpiece do not come into contact with any part of the worker's skin, particularly when perspiration is present or when clothing is wet. Well-insulated electrode holders and cables, dry clothing on the hands and body, and insulation from ground will be helpful.

. In confined spaces, arrange cables from coming in contact with falling sparks.

. Never change electrodes with bare hands or when gloves are wet, or when standing on wet floors or grounded surfaces.

. Ground the frames of all welding units in accordance with the requirements of the National Electric Code.

. Take proper care of cables. This includes replacing worn cables, keeping cables free from grease and oils, and keeping them away from power supply cables. Take precautions to prevent cables from becoming a tripping hazard. NEVER attempt to repair welding cables—replace them if they are damaged or worn.

Everyone must do their part to prevent injury in welding.

WELDING OPERATIONS ON FUEL TANKS, PAINTED METALS, AND CONTAINERS WHICH CONTAIN COMBUSTIBLE MATERIALS

Perhaps one of the most hazardous activities in the welding process is the welding and cutting of fuel tanks, painted metals, and containers which contain combustible materials. In the process of cutting or welding fuel tanks, the potential explosive nature of vapors amplifies the level of hazard already present within the operation.

Welding or cutting of materials which are painted or which contain combustible material such as polyurethane foam are dangerous in another way. The fire hazard and the vapors that are emitted from burning paint or foam can be extremely toxic. It is for this reason that all paint, foam, and other material should be removed from the workpiece before it is welded. Please note that removal should be accomplished through proper methods. The process of removing paint by burning it with a torch is not a proper method as heating of the paint causes hazardous fumes to enter the operator's breathing space. Additionally, all solvent and thinner residue should be washed from the workpiece prior to welding. Chlorinated hydrocarbons such as trichloroethylene and carbon tetrachloride should not be used for cleaning.

Although soldering is a common method for repairing fuel tanks, it is occasionally necessary to repair larger areas through the welding process. TM 9-237 lists several approved methods for purging and cleaning fuel tanks. The automotive-exhaust method and the steam-cleaning method are considered to be the best methods. There are some hazards to be considered when performing cleaning methods which should be addressed. Carbon monoxide poisoning is a potential hazard unless the automotive-exhaust method is performed in a well-ventilated area or with a shop exhaust system. Many methods call for the use of steam, hot water, and caustic solutions which require head and eye protection, rubber gloves, boots, and aprons during handling. Dry caustic soda and soda tasks also require long sleeves and respiratory protection. The regulations must be followed and personnel should not be performing acts such as climbing inside a fuel tanker to "scrub it out."

It is recommended that all tanks be tested (preferably within the last 30 minutes before welding) and tagged by the person performing the test to indicate the name and date of testing. Another method that may be helpful is to fill containers with water to a point that is within a few inches of the place that is to be welded. Be sure to leave the area vented so that heated air may escape during the heating process.

Only experienced personnel should be allowed to work on these types of workpieces. Vapor testing should be performed in every case and as close as possible to the time of welding. A low reading after the first cleaning may not be low after the tanker truck has been out in the sun all day. Care and monitoring of explosive vapors is a necessary control to prevent injury.

TRAILER-MOUNTED WELDING OPERATIONS

A typical Army trailer-mounted welding shop has the capability to perform oxyacetylene welding and cutting, shielded-metal arc welding, gas-metal arc welding, and metal-air-carbon arc cutting. The welding shop toolboxes contain all of the equipment necessary to perform these welding and cutting operations, and the necessary handtools. A common welding machine used on these trailers is a 350-amp constant current/constant voltage diesel-driven welding generator modified for military use and to accommodate the air compressor. Other common models are powered by 10 hp gasoline engines.

The hazards within the trailer-mounted welding operation are very similar to those of in-shop welding hazards. However, there are some additional factors to consider when trailer-mounted welding is performed. Additional hazards are present due to the portability of the equipment, power source, engine exhaust, and other factors.

Welding trailers should be grounded. This is a prevention against electrical shock and helps dissipate static electricity. It is a must the operator's ensure that ground has been accomplished prior to any attempt to operate the equipment. In accordance with FM 20-31, chap 3, section 5, grounding rods should be in the ground at least 8 feet or 2 full lengths of a 3-piece (9 foot) set. Tag the grounding rods so others won't trip over them.

The gasoline- and diesel-generated power system on the welding trailer has several hazards. The gasoline and diesel engines exceed permissible decibel levels. Workers should wear hearing protection to prevent permanent hearing loss. Filling the fuel tank requires a metal-to-metal contact between the container and fuel tank. This prevents a spark from being generated as the fuel flows over the metallic surfaces. Fuel tanks should not be filled while the engine is running and fuel should never be spilled on hot engine parts due to the danger of explosion. Workers should stand clear of the fan when the engine is started and ventilation should be adequate to remove exhaust fumes. Use of the welding trailer inside should not be attempted unless the exhaust is ventilated outside. Carbon monoxide is a deadly poison and exhaust fumes can kill with little warning.

Routine maintenance of the equipment poses several hazards. Only approved solvents should be used to clean equipment. Never use gasoline. Battery cables should be disconnected before removing such items as starter, fuel lines or alternators. If this is not accomplished, arcing could result which could injure the operator. No operator repairs should be performed while the equipment is still in operation. Turn off the welding machine before connecting the positive welding cable to the composite cable adapter flange. If the machine is not turned off, this action energizes the entire machine to arc welding voltage and may result in electrocution.

When installing wire into the wire feeder, ensure that the welding cable is disconnected from the composite cable adapter and that the welding machine is turned off before attempting to install new wire. Use a pencil or other soft

material to help guide the wire through the feed rollers. Use of fingers can result in injury. Additionally, the drive mechanism of the wire feeder and spool is a welding potential any time the welding machine is turned on and the welding gun activator is depressed. Death may result if contact is made with the welding wire or feeder rollers under these conditions.

Pressure should be released from air compressors when not in use or transported. Safety valves should be checked to ensure proper operation. Air compressors can explode. When setting up or changing out equipment on the trailer, be sure the lifting device is adequate for the weight of the item being moved. For example, when moving the welding machine, the lifting device should be rated for a capacity of 4,000. When moving the equipment, it should not be allowed to swing while it is suspended.

The gages and regulators should be removed from gas cylinders when being transported or not in use and cylinder caps should be in place. Always keep acetylene in an upright position and secure cylinders which are being transported on the trailer. There have been cases where cylinders became explosive projectiles because they fell off the trailer as it was traveling down the road.

Because of the need for mobile maintenance units which can provide support to front line areas, portable and trailer-mounted welding operations are here to stay. The job gets done faster and more efficiently when personnel take the proper safety precautions. Loss of personnel due to accidents makes it harder to accomplish the mission. It is everyone's responsibility to perform the job in the best possible manner, and is the safe way.

REMEMBER: ACCIDENTS ALWAYS HAPPEN TO THE OTHER GUY. TO EVERYONE ELSE,
YOU ARE THE OTHER GUY. NO ONE CAN PREVENT ACCIDENTS LIKE YOU CAN!

List of Additional Tailgate Topics

Inspection of lifting devices IAW TB 43-0142.

Submitting DA Form 1018 on TM.

Submitting QDR/EIR on equipment and tools. (DA Pams 738-750 and -751)

Unit SOP requirements (DA Pam 750-35).

Necessity for inspection of components.

When and when not to improvise—approved methods.

Using TMs—how to get, use, change. (DA Pam 25-30)

Ground guides in and around motor pool, track park, and maintenance shop.

Prejob checks.

Checking security of equipment on jack stands.

After-job checklists.

How to inspect tools. (TM 9-243)

Storage of compressed gas cylinders, AR 700-68.

Operator's Manual: Welding Theory and Application, TM 9-237.

FIRE HAZARDS
PROTECTIVE CLOTHING AND EQUIPMENT
USED IN WELDING OPERATIONS

Protective Clothing and Equipment

Protective clothing and equipment must be worn during welding operations. During all oxyacetylene welding and cutting processes, operators will use safety goggles to protect the eyes from heat, glare, and flying fragments of hot metals. During all electric welding processes, operators will use safety goggles and a hand shield or helmet equipped with a suitable filter glass to protect against the intense ultraviolet and infrared rays. When others are in the vicinity of the electric welding processes, the area must be screened so that the arc cannot be seen either directly or by reflection from glass or metal.

Helmets and Shields

Welding arcs are intensely brilliant lights. They contain a proportion of ultraviolet light which may produce eye damage. The brilliance and danger of the light depends on the welding method, current, and material being welded. Operators, fitters, and others working nearby need protection against arc radiation. Since arc radiation decreases rapidly in intensity with distance, the closest workers need the most protection.

The arc welder needs a helmet to protect the eyes and face from harmful light and particles of hot metal. The chief advantage of the helmet is that it leaves both hands free, making it possible to hold the work and weld at the same time.

The hand shield provides the same protection as the helmet except that it is held in position by the handle. This type shield is frequently used by an observer or a person who welds for a short period of time.

The protective welding helmet has a glass window, containing a filter lens especially made to prevent flash burns and possible eye damage by absorbing the infrared and ultraviolet rays produced by the arc. Lenses come in various optical densities with different shades to be used when welding various metals with different methods. The color of the lenses, usually green, blue, or brown, is an added protection against the intensity of white light or glare. Colored lenses make it possible to clearly see the metal and weld.

Gas metal-arc (MIG) welding requires darker filter lenses than shielded metal-arc (stick) welding, because it produces less smoke to absorb arc rays.

Do not weld with cracked or defective shields because penetrating rays from the arc may cause serious burns. Be sure that the colored glass plates are the proper shade for arc welding. Protect the colored glass plate from spatter by using a cover glass. Replace these cover glasses when damaged or spotted by molten metal spatter.

Face shields must also be worn where required to protect eyes. Welders must wear safety glasses, and chippers and grinders often use face shields as well.

In some welding operations, the use of mask-type respirators is required. Helmets with the "bubble" front design can be adapted for use with respirators.

Safety Goggles

During all electric welding processes, operators must wear safety goggles to protect their eyes from weld spatter which occasionally gets inside the helmet. These clear goggles protect their eyes from weld spatter which occasionally gets inside the helmet and also protect the eyes from slag particles when clipping and hot sparks when grinding.

Protective Clothing

Personnel exposed to the hazards created by welding, cutting, or brazing operations shall be protected by personal protective equipment in accordance with OSHA standards, subpart I, Personal Protective Equipment, paragraph 1910.132. Appropriate protective clothing required for any welding operation will vary with the size, nature, and location of the work to be performed.

Woolen clothing should be worn instead of cotton because wool is not easily burned or damaged by weld metal spatter, and it helps to protect the welder from changes in temperature. Cotton clothing, if used, should be chemically treated to reduce its combustibility. All other clothing such jumpers or overalls should be reasonably free from oil or grease.

Flameproof aprons or jackets made of leather or other suitable material should be worn for protection against spatter of molten metal, radiated heat, and sparks. Capes or shoulder covers made of leather or other suitable materials should be worn during overhead welding or cutting operations. Leather skull caps may be worn under helmets to prevent head burns.

Sparks may lodge in rolled-up sleeves or pockets of clothing or cuffs of overalls or trousers. Therefore, sleeves and collars should be kept buttoned and pockets be eliminated from the front of overalls and aprons. Trousers or overalls should not be turned up on the outside. For heavy work, fire-resistant leggings, high boots, or other equivalent means should be used. In production work, a sheet metal screen in front of the worker's legs can provide further protection against sparks and molten metal in cutting operations.

Flameproof gauntlet gloves, preferably of leather, should be worn to protect the hands and arms from the rays of the arc, molten metal spatter, sparks, and hot metal. Leather gloves should be of sufficient thickness so that they will not shrivel from heat, burn through, or wear out quickly. Do not allow oil or grease to come in contact with the gloves because this will reduce their flame resistance and cause them to be readily ignited or charred.

Protective Equipment

Where there is exposure to sharp or heavy falling objects or a hazard of bumping in confined spaces, hard hats or head protectors should be used.

For welding and cutting, overhead, or in confined spaces, ear protection is sometimes desirable.

When welding in any area, the operation should be adequately screened to protect nearby workers or passers-by from the glare of welding. The screens should be so arranged that no serious restriction of ventilation exists. The screens should be so mounted that they are about 2 feet above the floor unless the work is performed at so low a level that the screen must be extended nearer the floor to protect the adjacent worker. The height of the screen is normally 6 feet but may be higher depending upon the situation. The screens, if metal, should be painted with a finish of low reflectivity such as zinc oxide (an important factor for absorbing ultraviolet light) and lamp black. If either materials are used, the surface should be of low reflectivity.

Lens Shades for Welding and Cutting

METHOD	ELECTRODE DIAMETER, INCH	METAL THICKNESS, INCH	LENS* NUMBER
Welding			
Shielded metal- arc	1/16 to 5/32		10
	3/16 to 1/4		12
	5/16 to 3/8		14
MIG	1/16 to 5/32	Ferrous	12**
		Nonferrous	11
TIG		Ferrous	12**
		Nonferrous	11
Atomic hydrogen			10 to 14
Carbon-arc			14
Air-arc cutting	5/32 to 1/4 carbon		10 to 14
Gas torch		to 1/8	4 or 5
		1/8 to 1/2	5 or 6
		over 1/2	6 or 8
Brazing Torch		to 1	3 OR 4
Cutting Torch		1 to 6	3 or 4***
		over 6	4 or 5
Soldering Torch			5 or 6
			2

*Too dark a lens causes eyestrain.

Besides helmet, operator wears No. 2 flash goggles. Close workers, same goggles. *Goggles need side shields.

NOTE

This colored glass must be manufactured in accordance with specifications detailed in the "National Safety Code for the Protection of Hands and Eyes of Industrial Workers," issued by the National Bureau of Standards, Washington, D.C.; and OSHA Standards, Subpart Q, "Welding, Cutting, and Brazing," paragraph 1910.252; and American National Standards Institute Standard (ANSI) Z87.1, "American National Standard Practice for Occupational and Educational Eye and Face Protection."

Fire Hazards

Fire prevention and protection is the responsibility of welders, cutters, and supervisors. The elaboration of basic precautions to be taken for fire prevention during welding or cutting is outlined in the Standard for Fire Prevention in Use of Cutting and Welding Processes, National Fire Protection Association Standard 51B. Some of the basic precautions for fire prevention in welding or cutting work are given below.

During the welding and cutting operations, sparks and molten spatter are formed and sometimes fly appreciable distances. For this reason, welding or cutting should not be done near flammable materials unless every precaution is taken to prevent ignition.

Whenever possible, flammable materials attached to or near equipment requiring welding, brazing, or cutting should be removed. If removal is not practical, a suitable shield of heat-resistant material should be used to protect the flammable material. Fire extinguishing equipment for any type of fire that may be encountered is to be present.

When welding or cutting parts of vehicles, the oil pan, gasoline tank, and other parts of the vehicle should be considered fire hazards and effectively shielded from sparks, slag, and molten metal.

Health Protection

Requirements have been established on the basis of the following factors in arc and gas welding and cutting which govern the amount of contamination to which welders may be exposed:

- Dimensions of space in which welding is to be done (with special regard to height of ceiling).
- Number of welders.
- Possible evolution of hazardous fumes, gases, or dust according to the metals involved.
- Location of welder's breathing zone with respect to rising plume of fumes.

It is recognized that in individual instances other factors may be involved, in which case ventilation or respiratory protective devices should be provided as needed to meet the equivalent requirements. Such factors would include:

- Atmospheric conditions.
- Heat generated.
- Presence of volatile solvents.

However, in all instances the required health protection, ventilation standards, and standard operating procedures for new as well as old welding operations should be coordinated and cleared through the safety inspector and the industrial hygienist having responsibility for the safety and health aspects of the work area.

Screened Areas

When welding must be performed in a space entirely screened on all sides, the screens shall be so arranged that no serious restriction of ventilation exists. It is desirable to have the screens so mounted that they are about 2 feet above the floor unless the work is performed at so low a level that the screen must be extended nearer to the floor to protect workers from the glare of welding.

Concentration of Toxic Substances

Local exhaust or general ventilating systems shall be provided and arranged to keep the amount of toxic fumes, gas, or dusts below the acceptance concentration of toxic dust and gases: American National Standard Institute Standard; the latest Threshold Limit Values (TLV) of the American Conference of Governmental Industrial Hygienists; or the exposure limits as established by Public Law 91-596, Occupational Safety and Health Act of 1970. Compliance shall be

determined by sampling of the atmosphere. Samples collected shall reflect the exposure of the persons involved. When a helmet is worn, the samples shall be collected under the helmet.

NOTE

Where welding operations are incidental to general operations, it is considered good practice to apply local exhaust ventilation to prevent contamination of the general work area.

Respiratory Protective Equipment

Individual respiratory protective equipment should be well maintained. Only respiratory protective equipment approved by the U.S. Bureau of Mines, National Institute of Occupational Safety and Health, or other governmental-approved testing agency shall be utilized. Guidance for selection, care, and maintenance of respiratory protective equipment is given in Practices for Respiratory Protection, American National Standard Institute Standard Z88.2 and TB Med 502. Respiratory protective equipment should not be transferred from one individual to another without being disinfected.

Precautionary Labels

A number of potentially hazardous materials are employed in fluxes, coatings, covering, and filler metals used in welding and cutting or are released to the atmosphere during welding and cutting. These include, but are not limited to, the materials itemized below.

. The suppliers of welding materials shall determine the hazard, if any, associated with the use of their materials in welding, cutting, etc.

. All filler metals and fusible granular materials shall carry the following notice, as a minimum, on tags, boxes, or other containers:

CAUTION

Welding may produce fumes and gases hazardous to health. Avoid breathing these fumes and gases. Use adequate ventilation. See American National Standards Institute Standard Z49.1, Safety in Welding and Cutting, published by the American Welding Society.

. Brazing (welding) filler metals containing cadmium in significant amounts shall carry the following notice on tags, boxes, or other containers:

WARNING
CONTAINS CADMIUM - POISONOUS
FUMES MAY BE FORMED ON HEATING

Do not breathe fumes. Use only with adequate ventilation such as fume collectors, exhaust ventilators, or air-supplied respirators. See American National Standards Institute Standard Z49.1.

If chest pain, cough, or fever develops after use, call a physician immediately.

Brazing and gas-welding fluxes containing fluorine compounds shall have a cautionary wording to indicate that they contain fluorine compounds. One such cautionary wording recommended by the American Welding Society for brazing and gas-welding fluxes reads as follows:

CAUTION
CONTAINS FLUORIDES

This flux, when heated, gives off fumes that may irritate eyes, nose, and throat.

Avoid fumes—use only in well-ventilated spaces.

Avoid contact of flux with eyes or skin.

Do not take internally.

Acetylene - Red Dot Flammable Gas Tag

1. General Information

a. Acetylene burns at a temperature of 5400-6300°F in air. The predominant uses of this gas on depot are oxyacetylene cutting, heat treating, and possibly as a fuel for some laboratory instruments.

b. The predominant hazard associated with acetylene is its high flammability. There is no known chronic effect from breathing the vapors. Acetylene is shipped dissolved in acetone. Cylinders intended for acetylene are filled with a porous material which holds the acetone in the cylinder as the acetylene is released. At 175 lbs psia, 1 volume of acetone will hold 300 volumes of acetylene into solution. A full cylinder has 250 lbs pressure at 70°F.

c. Acetylene is only slightly lighter than air. Caution should be exercised in areas where free acetylene could be present, because of its wide flammability range.

2. Specifics in Handling

a. In its free state under pressure, acetylene can decompose violently, causing an explosion. The pressure of acetylene in its free state should never exceed 15 psig. Acetylene gas under free state of 29.4 psi is self-explosive.

b. Cylinders should be stored and used in an upright position to prevent leakage of acetone. Should the acetone leak out, free acetylene under pressure would be left in the cylinder.

c. Close the cylinder valve before the regulator valve so that free acetylene is not trapped between the cylinder and regulator.

d. Never store near reserve stocks of oxygen. A minimum of 100 feet is the required separation distance unless separated by a firewall. This is the Army standard contained in AR 700-68, enclosure 1, paragraph 5.31. Although oxygen and acetylene must have a 20-foot separation distance as listed, 29 CFR 1910.252(a)(2)(iii) and (iv), the Army standard is more stringent and, therefore, must be followed.

e. Never store near an open flame nor where the gas could diffuse to a flame or spark in the event of a leak.

f. Make sure valves are closed on empty cylinders to prevent evaporation of acetone.

g. If cylinder was not received in an upright position, make sure it sets upright at least 30 minutes prior to use.

h. Steel or wrought iron are recommended materials for fittings. Cast iron, copper, silver, mercury, 70/30 brass and aluminum bronze all readily replace one or more hydrogen molecules in acetylene and form acetylides. Coupled with moisture and oxygen or carbon dioxide, these compounds are highly explosive.

3. Safety Devices and Fire Prevention

The safety devices are fuse metal on all acetylene cylinders. This means that only an increase in internal temperature will trigger the device and cause release of the contents. Flames and molten metal coming in contact with the cylinder can sometimes be enough to trigger the release device causing discharge of the cylinder contents and possibly a fire. Small fires can sometimes be extinguished by throwing putty or some other wet material onto the point of release. In all cases, the area should be evacuated of all personnel but those experienced in handling the situation.

4. Recommended Controls

Automatic pressure regulators to deliver pressures not to exceed 15 psig should be used. Leak tests using soapy water and watching for bubble formation should be done periodically.

Oxygen - Red Dot Flammable Gas Tag

1. General Information

Oxygen is colorless, odorless, and tasteless. It is nonflammable in itself, but support combustion. Oil or grease must never be allowed to come in contact with oxygen cylinders, valves, regulators, gauges, or fittings since the combination of oxygen and oil may result in an explosion. Uses of oxygen are many, on depot use is predominantly in the area of cutting and welding. It is usually supplied as a nonliquefied gas at 2200 psig at 70° F.

2. Specifics in Handling

- a. Never allow oxygen to come in contact with oil, grease, or other readily combustible compounds.
- b. Do not lubricate oxygen valves, regulators, gauges, or fittings with oil or any other combustible material.
- c. Avoid allowing the cylinder to come in contact with electrical circuits.
- d. Cylinders should not be stored within 50 feet of any flammable or combustible material unless separated by a noncombustible barrier at least 5-feet high and having a fire resistance rating of 1/2 hour.
- e. Lines and equipment should be pretested with an inert gas such as nitrogen. Any periodic testing of lines, fittings, etc., should be performed with an oil-free and nonflammable material.

3. Safety Relief Devices

Either frangible disc or frangible disc backed with fusible metal melting at 212° F are the safety devices utilized with compressed oxygen and are an integral part of the cylinder valve, located just opposite the outlet. If the cylinder is to be filled to more than 10 percent of its rated pressure capacity, only the frangible disc type relief device may be utilized.

Helium - Green Dot Flammable Gas Tag

1. General Information

Helium is lighter than air, nonflammable, and does not support combustion. The gas itself is nontoxic but may act as a simple asphyxiant when high concentrations are breathed. Predominant uses include arc welding as an inert shield, balloons used in weather forecasting and, mixed with oxygen may be used for breathing by divers working under high pressure or hospital patients suffering from asthma or other obstructive respiratory conditions. Normally, helium is supplied as a nonliquefied gas in cylinders at about 2200 psig at 70° F.

2. Specifics in Handling

General rules for safe handling of compressed gases should be followed.

3. Safety Devices

Safety reliefs of the frangible disc type or frangible disc backed by fusible metal melting at approximately 212° F. are normally used. Cylinders pressurized 10 percent above their marked service pressure must have only the frangible type relief device.

Argon - Green Dot Tag

1. General Information

Argon is a colorless, odorless, and tasteless inert gas. It is considered nontoxic and will not support combustion. Normally, it is supplied in gaseous form in cylinders at a pressure of approximately 2200 psig at 70° F. Uses of argon include arc welding as an inert gas shield to prevent oxidation of the metals being welded, some plasma jet torches, and filling of incandescent light bulbs.

2. Specifics in Handling

- a. Argon is nontoxic but can act as an asphyxiant by displacing air in high concentrations.
- b. When electric arc welding, take care not to strike an arc across the cylinder.
- c. Leak detection should be accomplished by painting lines with soapy water.

3. Safety Devices

Either the frangible disc or frangible disc backed with fusible metal may be used as safety devices on argon cylinders. These devices are usually an integral part of the cylinder valve, situated opposite the valve outlet.

Carbon Dioxide - Green Dot Tag

1. General Information

Carbon dioxide is nonflammable, does not support combustion. Uses of CO₂ include refrigeration (dry ice), fire extinguishing (inerts the flammable material), shielded arc welding and pressure spraying in packaging. Blown directly on the body, CO₂ may cause freeze burns so care must be exercised when using. In addition, CO₂ in high concentrations may paralyze the respiratory system. Concentration of 10 percent may be endured for only a few minutes, 12-15 percent concentrations can cause unconsciousness. Since carbon dioxide is about 1 1/2 times heavier than air and can settle into confined or unventilated spaces, it should be used in open or well-ventilated areas.

2. Specifics in Handling

- a. Do not place in areas where the cylinder could become part of an electric arc.
- b. Do not store cylinders in subsurface or enclosed areas or discharge in confined or poorly ventilated areas.
- c. Wear protective clothing and gloves when handling liquid CO₂. Spillage on the skin can cause frostbite.

3. Safety Devices

The only type of safety device permitted on CO₂ cylinders for industrial use is the frangible disc type.

NAME OF OFFICE

STANDING OPERATING PROCEDURE NO. _____

DATE _____

Welding Shop Operations

1. Purpose. To establish safe operating procedures and assign responsibilities to cover welding shop operations, portable welding operations, and welding maintenance activities.

2. Applicability. This procedure applies to the cleaning, maintenance, and operation of welding equipment to include the storage of compressed gases and equipment setup.

3. Responsibility. The immediate supervisor is responsible for:

a. Application and enforcement of this procedure.

b. Ensuring only qualified personnel are permitted to engage in these operations.

c. Ensuring building leaders and subordinates are thoroughly briefed regarding qualified personnel being allowed to engage in these operations.

d. Ensuring workers are familiar with hazardous materials data pertaining to their particular operation.

4. Location of operations. Building _____.

5. Material limits. The type and amount of welding equipment in use will be limited to the number and quantity needed to perform a safe and efficient operation.

6. Personnel limits. The number of persons exposed to welding operations will be the minimum required to safely perform the operation. This includes complete use of protective equipment for all personnel involved.

7. Safety requirements. Industrial requirements include those listed below:

a. Hazardous materials safety data sheets will be obtained from the manufacturer or procurement source. Chemicals which are necessary to the operation which do not have safety data sheets should be brought to the attention of safety and industrial hygiene personnel.

b. Personnel will be aware of and trained in the hazards of all chemicals, equipment, and solvents used, to include personal protective equipment and maintenance requirements.

c. Welding operations will not be any closer to flammable solvents or dip tanks than at least 20 feet from the maximum vapor area. Smoking, flame, and

welding operations will be at least 50 feet from any flammable or compressed gas storage area. Compressed gas storage will meet the requirements contained in AR 700-68.

d. All equipment will be inspected before and after use. Personal protective equipment will be worn and all welding equipment and workpieces will be grounded. Respiratory protection will be utilized when it is determined necessary or when mechanical ventilation fails to dissipate fumes below allowable limits.

e. Trailer-mounted welding equipment will be grounded before use. Diesel- and fuel-gassed equipment will have exhaust ventilated to the outside of the building. Equipment will not be refueled while in operation and metal-to-metal contact will be achieved during the refuel process to minimize arcing and sparks.

f. Welding will not be performed in the vicinity of flammable and combustible materials. Fuel tanks and containers which held flammable or combustible materials will be properly purged and vapor tested (recommended within the last 30 minutes) before welding is performed. Those workpieces which are painted or which contain polyurethane will have the paint and foam removed from the work area to prevent hazardous fumes and possible material ignition.

g. Fire extinguishers will be present in case of fire. Personnel will be trained in fire prevention techniques and proper methods for cleaning up spills and disposal of hazardous materials.

h. Other applicable operation items should be listed as they pertain to unique equipment and processes.

8. Posted. After this sample SOP has been developed and approved by the concerned command, a copy should be posted in an area accessible to all employees.

SUBMITTED BY: _____

RECOMMENDING APPROVAL: _____

APPROVED: _____

Welding Safety Checklist

1. Are only qualified and authorized personnel permitted to perform welding operations? (29 CFR 1910.252(a)(1)(iv); (b)(1)(iii); (b)(4)(i); and (c)(1)(iii))
2. Is proper PPE (such as helmets, eye protection shields, goggles, leather aprons or jackets, gloves, and in some cases safety belts or life lines) provided? (29 CFR 1910.132; 1910.252(e); and ANSI Z49, 7.2-7.3)
3. Do personnel wear appropriate protective equipment for the operation being performed; welding helmets with correct lens rating; leather and wool clothing, etc.? (TM 9-237, para 4-2; 29 CFR 1910.252(e))
4. Is an exhaust system provided to remove injurious fumes and gases? (29 CFR 1910.252(f)(2))
5. Have flammable or explosive materials been removed or shielded to eliminate the possibility of fire or explosion during welding work? (29 CFR 1910.252(d)(2)(vii); TM 9-237, para 4-1)
6. Do you ensure that containers which have held flammable or combustible material have been purged so that the gage indicates no fumes remain? (The modification work order should be inclusive of all parts to be purged.) (TM 9-237, Sec V; 29 CFR 1910.252(d)(3); and ANSI Z49, 3.4.2 and 6.4)
7. Do workpieces which contain polyurethane foam assemblies have the foam removed prior to welding? (TM 9-237, para 4-25)
8. Are written SOPs governing the selection and proper use of respirators available? (29 CFR 1910.134(b)(1))
9. Are respirators selected on the basis of hazards to which the work is exposed? (29 CFR 1910.134(b)(2))
10. Are the users instructed and trained in the proper use of respirators and their limitations? (29 CFR 1910.134(b)(3))
11. Are respirators thoroughly cleaned and disinfected after each use? (29 CFR 1910.134(b)(5); TB Med 502, para 2-8)
12. Are personnel who use respirators given a physical examination to determine if they are physically able to perform the work and use this equipment? (29 CFR 1910.134(b)(10))
13. Are curtains or screens provided around all welding locations? (29 CFR 1910.252(e)(2)(iii); TM 9-237, para 4-2(e)(3))
14. Are cylinders stored away from heat sources, stored in an upright position, and chained or secured to prevent falling? (AR 700-68; 29 CFR 1910.252(a)(2); and ANSI Z49, 3.2.3)

15. Are filled and empty cylinders stored separately? (AR 700-68, para 5.2c)
16. Are hazardous materials safety data sheets available to all employees on all chemicals, rods, electrodes, and other potentially hazardous materials used within the welding operation? (29 CFR 1910.1200)
17. When a special wrench is provided to open the stem of a compressed gas cylinder, is the wrench left in place while the operation is ongoing for emergency shut off? (29 CFR 1910.252a(2)(v)(c)(12); and ANSI Z49, 3.2.5.4)
18. Are welding machines grounded? (29 CFR 1910.252; TM 9-237, paras 4-10 and 4-11; and applicable welding equipment technical manuals)
19. Is acetylene gas used at a pressure not to exceed 15 pounds per square inch (PSI) (higher pressure may cause it to explode)? (AR 700-68, para 2.1a; 29 CFR 1910.252(a)(ii))
20. When cylinders are not in use, are valves closed and valve protector caps in place (where cylinder is designed to accept a cap)? (AR 700-68, para 5.1a13; 29 CFR 1910.252(a)(2)(ii); and ANSI Z49, 3.2.4 and 3.6.5)
21. Do employees know they are never to use compressed gas to dust off clothing or other objects? (The tremendous pressure can cause an air bubble to enter the blood stream or a piece of cloth, jewelry, etc., to imbed itself in the skin.) (AR 700-68, para 5.1(a)(16))
22. Is smoking prohibited within 50 feet of compressed gas storage areas, and are "NO SMOKING" signs posted? (AR 700-68, para 5.2b)
23. Are oxygen regulator gages marked "USE NO OIL?" (29 CFR 1910.252(5)(vi); and ANSI Z49, 3.5.7)
24. Before connecting the regulator to the oxygen cylinder, do you stand to one side of the outlet when opening the valve? (29 CFR 1910.252(a)(2)(v)(b)(16); and ANSI Z49, 3.2.5)
25. When manifolding cylinders, do you ensure the manifolds and parts included are used only for the approved gases? (29 CFR 1910.252(a)(3)(v)(c); and ANSI Z49, 3.3.1)
26. When a leak develops around the valve stem of a fuel-gas cylinder, do you remove the cylinder to the outdoors, open the valve slightly so the gas can leak, tag the cylinder, and advise the supplier? (ANSI Z49, 3.2.5.6; 29 CFR 1910.252(a)(2)(v)(c)(6))

**HAZARDOUS MATERIALS
USED IN WELDING OPERATIONS**

This listing details some typical chemical materials used by maintenance facilities to repair and maintain equipment through welding operations. Due to the number of chemicals used within the Army, it is not possible to list all of them. Items having a Federal Stock Number can be located in the DOD Hazardous Materials Microfiche 6050.5-LR (can be ordered on publications requisition) in order to evaluate hazards, storage, and personal protective equipment requirements. If the material does not meet the description on the microfiche, is omitted from the microfiche, or is a local purchase item, hazardous materials safety data sheets should be obtained from the procurement source or manufacturer. Local procedures for handling this matter should be coordinated with local safety personnel.

Safety data sheets are required to be maintained on all potentially hazardous chemicals used in the operation. These are to be accessible to all workers or within 1 hour of supervisor notification. This is required by 29 CFR 1910.1200. These data sheets are to be used by the supervisor to make informed decisions concerning hazards, equipment, protective gear, and storage to ensure compliance with Federal standards.

The following examples indicate that certain materials in welding are hazardous. Please note that rods, electrodes, and other materials used in welding are different, depending upon the operation. Hazards often vary with the type of rod, alloy, flux, or workpiece being welded upon. It is for this reason that safety data be obtained, employees trained, protective equipment used, and operations monitored by industrial hygiene/safety personnel.

Welding Electrode
NSN 3439-00-246-9545
MIL-E-13080

Hazard class: Not required for transportation.

Materials to avoid: Avoid storing with corrosive materials. Never weld near flammable or combustible material.

Effects of overexposure: Pulmonary irritation from dust inhalation. Products of decomposition include ozone and oxides of nitrogen.

Protective equipment: Operators should utilize protective welding gloves and clothing to prevent injury from hot sparks and metal. Welders helmet and face shield with a suggested #12 lens. Natural ventilation is usually sufficient. In poorly ventilated areas or confined spaces, mechanical ventilation, welding fume respirators, or airline respirators may be necessary to keep concentrations within allowable limits.

First aid: Seek medical attention for all burns and eye exposure to welding process. Move victim to fresh air if dust is inhaled.

Silver Brazing Alloy (Contains Cadmium)
NSN 3439-00-262-4186
SPEC QQ-B-654

Safety precautions: Provide good ventilation and avoid overheating. Overheating of the metal will result in release of metal fumes which can be fatal.

Effects of overexposure: Effects of inhalation and ingestion are as follows:

a. Cadmium poisoning.

b. Vomiting, diarrhea, headache, dizziness, fever, chest pain.

Fire fighting data: Fire fighters should use self-contained breathing apparatus or metal vapor respirators in confined areas.

Protective equipment: Gloves, goggles, and other routine welding equipment to prevent prolonged exposure. Local exhaust or mechanical ventilation should be used to keep air contamination within allowable limits. In areas of low ventilation, self-contained breathing apparatus should be used.

First aid: Keep patient warm and seek immediate medical assistance.

Waste elimination: This alloy has some reclaim value because of the silver and copper content. Consult Federal, state, and local regulations.

Welding Electrode
NSN 3439-00-262-2670
SPEC QQ-E-450 (Contains Asbestos)

Safety precautions: Use in well-ventilated areas. Arc and sparks could be sources of ignition to combustible and flammable materials.

Effects of overexposure: Inhalation of fumes—fainting and nausea.

Protective equipment: Welding gloves and protective clothing to include leather apron. Welding helmet and glasses should be worn with a color absorption lens of #9-12. Local and mechanical ventilation should be used and a NIOSH-approved respirator should be worn to control exposure above allowable limits.

First aid: Move the victim to fresh air and call a physician.

Welding Brazing Soldering Flux
NSN 3439-00-255-4572

Safety precautions: This flux contains boric acid. Boric acid can react with some bases to form borate salts. Boric acid can also be dangerous when absorbed through cuts and other breaks in the skin. Protective gloves should be worn whenever handling the flux, especially if skin has been injured. Welding gloves should be worn during the welding process.

Effects of overexposure: The effects of overexposure are as follows:

a. Skin and eye irritation: Welding infrared radiation can permanently injure eyes.

b. Brazing and gas welding produce fumes which can harm health.

c. Absorption of boric acid through injured skin or through inhalation may result in depression, shock, respiratory and circulatory failure, coma, and death.

d. Other hazards and severity depend upon welding rod used.

Protective equipment: Safety glasses or goggles, fire-resistant clothing which complies with ANSI Standard Z49.1, and welding gloves should be worn. Welding fumes cannot be classified simply. Allowable limits of fumes depend upon composition and quantity of alloy being welded and materials used. Local exhaust, mechanical ventilation, and a NIOSH-approved respirator may be necessary depending upon the exposure of concern.

First aid: CALL FOR MEDICAL ASSISTANCE.

a. Skin: Wash skin thoroughly with soap and water.

b. Eyes: Flush with water for 15 minutes.

c. If ingested, call a doctor. If breathing becomes difficult, give oxygen.

Spill and leak control: Avoid breathing of dust. Scoop up material and flush residue with water into a chemical sewer. Waste elimination should be in compliance with local, state, and Federal regulations.

Zinc Chloride Soldering Flux
NSN 3439-00-255-4568

Safety precautions: This material is corrosive and should not be stored with strong alkali materials. Flux solution should be kept in glass or plastic containers. Tools used should be nonsparking. Avoid inhaling flux fumes, welding fumes, and avoid skin contact.

Effects of overexposure: Inhalation of fumes may irritate respiratory tract. Skin and eyes may be irritated or burn from prolonged contact.

Protective equipment: Goggles and protective rubber gloves should be worn when handling flux. During the welding process, protective clothing should comply with ANSI Standard Z49.1. Local exhaust- and air-supplied respirators should be used to eliminate mists, fumes, and gases.

First aid: Call for medical assistance.

a. Skin and eyes. Flush with water for 15 minutes. Remove contaminated clothing.

b. Inhalation. Move victim to fresh air. Give oxygen or CPR if needed.
(Caution: CPR may expose rescuer.)

Spills and cleanup: Proper protective equipment should be used during cleanup. Any absorbent material may be used. Tools should be nonsparking. Place in a closed container. Dispose of IAW local, state, and Federal regulations. DO NOT dump into water system.

**SAMPLE JOB SAFETY
BREAKDOWN SHEETS**

These Sample Job Safety Breakdown Sheets may be used to prepare similar analysis of local operations. Although modification is necessary to suit individual needs, the samples provide a workable method of safety evaluation and job/task analysis.

JOB SAFETY BREAKDOWN SHEET
SAMPLE

INSTRUCTION UNIT:	OPERATION:	JOB:
	Welding	Welder
STEPS	KEY POINTS	SAFETY INSTRUCTIONS
Welding	Proper protective equipment	Be sure goggles or helmet fit properly with correct shade or lens. Wear gloves and welding jacket at all times when welding. Leather apron is required for electric welding. All welding will be properly shielded to protect other workers. Properly fitted clothing and welding boots will be worn to prevent flying sparks and burning metal from contacting body.
	Explosive tanks	A container known to have held a flammable liquid shall be purged with steam for a 3-hour continuous period prior to requesting a vapor test.
Securing Area Equipment	Area	<ol style="list-style-type: none"> 1. Mark hot surfaces: "HOT" or post a "WARNING-HOT" sign. 2. Place hot metal in proper containers. 3. Make final check of area to be sure all sparks and burning materials are out or have been extinguished.
	Equipment	<ol style="list-style-type: none"> 1. Close all tank valves, drain hoses, disconnect electric welders, shut off gasoline-driven engines and check for gas leaks. 2. Disconnect all electrical power tools and return them to their proper storage area. 3. Electrodes will always be removed from electrode holder upon completion of a job or when securing leads on welding machine.

**JOB SAFETY BREAKDOWN SHEET
SAMPLE**

INSTRUCTION UNIT:	OPERATION:	JOB:
	Welding	Welder
STEPS	KEY POINTS	SAFETY INSTRUCTIONS
Check Equipment and Area	Housekeeping	<p>1. Keep working area free of obstacles that may cause tripping and slipping.</p> <p>2. Keep area free of combustible materials such as clothing, paper, rags, wood, greases, magnesium particles, etc.</p>
	Ventilation	Utilize all available exhaust systems to prevent breathing fumes.
	Electric welder	Perform daily checks for broken electrode holders, grounds, cables, loose connections, etc.
	Acetylene equipment	Secure tank(s) upright, ensure gages and valves work properly, close valves when not in use, observe position of acetylene and oxygen hoses to prevent burn-throughs.
Preparing Materials Weld	Grinding, sanding	Face shield or goggles (whichever is more comfortable/appropriate for the job) will be utilized.
	Paint removal	All solvents, paint, and residue will be removed prior to welding an area.
	Utilization of pneumatic tools (chisels, hammers, wrenches, etc.)	Ear muffs or earplugs will be utilized.
	Cramped quarters	Avoid awkward positions to prevent strain, allow sufficient room to move freely when lifting, keep back straight, bend at knees and lift with leg muscles.

JOB SAFETY BREAKDOWN SHEET
SAMPLE

INSTRUCTION UNIT:	OPERATION:	JOB:
	Welding	Welder
STEPS	KEY POINTS	SAFETY INSTRUCTIONS
	Securing of materials	All materials to be welded will be properly clamped or secured in an appropriate welding fixture to prevent slipping or falling.
Safety	Protective clothing	<ol style="list-style-type: none"> 1. Steel-toed shoes or boots will be worn at all times. Industrial safety glasses, goggles, or face shields will be worn as necessary. NOTE: Metal frame safety glasses are prohibited when welding. 2. Approved respirator will be worn as required. 3. Approved hearing protection will be worn as necessary. 4. Operators with long hair styles will wear flame-retardant cap to cover all hair.
	Pinch points	Avoid all areas where one could get fingers and hands injured.
	Transporting of materials	No sheet metal, plates, or materials of similar nature that may have a tendency to slip from forklift prongs will be transported without being secured with a clamping device.
	Hand tools	All hand tools will be inspected daily and will be replaced when signs of damage are present or when flaws appear.
	Electric welders	All electric welders will be kept clean and will be blown out weekly.

**JOB SAFETY BREAKDOWN SHEET
SAMPLE**

INSTRUCTION UNIT:	OPERATION:	JOB:
	Welding	Welder
STEPS	KEY POINTS	SAFETY INSTRUCTIONS
	Lifting devices	Cables, chains, slings, and lifting devices will be checked daily. Properly tagged/stenciled for rated lifting capacities, load testing, and inspection due dates.
	Work area	Good housekeeping must be maintained at all times.
	Training-first aid/CPR	Welders will be trained in the latest techniques pertaining to cardiopulmonary resuscitation (CPR) and first aid.